

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB 2004/004246

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: G06F 3/00, G05B 19/409

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: G06F, G05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO, INTERNAL, PAJ, WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 1271293 A2 (NOKIA CORPORATION), 2 January 2003 (02.01.2003), whole document --	1-24
Y	WO 0192944 A1 (GRASSE LUIGI), 6 December 2001 (06.12.2001), claim 4, abstract --	1-24
A	US 20020044104 A1 (WOLFGANG FRIEDRICH ET AL), 18 April 2002 (18.04.2002), whole document --	1-24
A	US 20020191004 A1 (JOHN FRANKLIN EBERSOLE ET AL), 19 December 2002 (19.12.2002), abstract -- -----	1-24

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier application or patent but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search

2 May 2005

Date of mailing of the international search report

04-05-2005

Name and mailing address of the ISA/
Swedish Patent Office
Box 5055, S-102 42 STOCKHOLM
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Authorized officer

Henrik Eriksson /itw
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB 2004/004246

EP	1271293	A2	02/01/2003	GB	0115765	D	00/00/0000
				GB	2377147	A	31/12/2002
				US	20030020707	A	30/01/2003

WO	0192944	A1	06/12/2001	AT	286265	T	15/01/2005
				AU	6749801	A	11/12/2001
				DE	10027136	A,C	16/05/2002
				DE	50104974	D	00/00/0000
				EP	1285303	A,B	26/02/2003
				EP	1515176	A	16/03/2005

US	20020044104	A1	18/04/2002	DE	50003377	D	00/00/0000
				EP	1183578	A,B	06/03/2002
				JP	2002538542	A	12/11/2002
				DE	50003357	D	00/00/0000
				DE	50003531	D	00/00/0000
				DE	50007901	D	00/00/0000
				DE	50007902	D	00/00/0000
				EP	1157314	A,B	28/11/2001
				EP	1157315	A,B	28/11/2001
				EP	1157316	A,B	28/11/2001
				EP	1159657	A,B	05/12/2001
				JP	2002538541	A	12/11/2002
				JP	2002538543	A	12/11/2002
				JP	2002538700	A	12/11/2002
				JP	2003524814	T	19/08/2003
				US	20020046368	A	18/04/2002
				US	20020049566	A	25/04/2002
				US	20020067372	A	06/06/2002
				US	20020069072	A	06/06/2002
				WO	0052536	A	08/09/2000
				WO	0052537	A	08/09/2000
				WO	0052538	A	08/09/2000
				WO	0052539	A	08/09/2000
				WO	0052540	A	08/09/2000
				WO	0052541	A	08/09/2000
				WO	0052542	A	08/09/2000

US	20020191004	A1	19/12/2002	US	20030210228	A	13/11/2003
				US	20020191003	A	19/12/2002
				US	20020196202	A	26/12/2002
				AU	2002366994	A	00/00/0000
				CA	2473713	A	24/07/2003
				EP	1466300	A	13/10/2004
				WO	03060830	A	24/07/2003

PATENT COOPERATION TREATY

REC'D 11 MAY 2005

WIPO

PCT

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

Nick Warren
Legal & Compliance/
Intellectual
Forskargränd 8
721 78 Västerås

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

Date of mailing
(day/month/year)

04 -05- 2005

Applicant's or agent's file reference

9628wo/nw/mz

FOR FURTHER ACTION

See paragraph 2 below

International application No.

PCT/IB2004/004246

International filing date (day/month/year)

20-12-2004

Priority date (day/month/year)

31-12-2003

International Patent Classification (IPC) or both national classification and IPC

G06F 3/00, G08B 19/409

Applicant

ABB RESEARCH LTD et al

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further opinions, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA/SE

Patent- och registreringsverket

Box 5055

S-102 42 STOCKHOLM

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Authorized officer

Henrik Eriksson / ITW

Telephone No. +46 8 782 25 00

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/IB2004/004246

Box No. I **Basis of this opinion**

1. With regard to the language, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
☐ This opinion has been established on the basis of a translation from the original language into the following language, _____, which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).
2. With regard to any nucleotide and/or amino acid sequence disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:
 - a. type of material
☐ a sequence listing
☐ table(s) related to the sequence listing
 - b. format of material
☐ in written format
☐ in computer readable form
 - c. time of filing/furnishing
☐ contained in the international application as filed.
☐ filed together with the international application in computer readable form.
☐ furnished subsequently to this Authority for the purposes of search.
3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments:

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/IB2004/004246

Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	<u>1-24</u>	YES
	Claims	_____	NO
Inventive step (IS)	Claims	_____	YES
	Claims	<u>1-24</u>	NO
Industrial applicability (IA)	Claims	<u>1-24</u>	YES
	Claims	_____	NO

2. Citations and explanations:

The claimed invention relates to a system and a method that enable a user to interact with a virtual control panel. The invention can be applied to different industrial processes, where a user needs a control panel for interacting with a device or a system. The object of the invention is to provide a portable control panel that the user can carry with him/her. The interaction between the user and the devices is also simplified, since the interfaces can be standardized. The user only has to interact with a single interface, which changes its representation in dependence of the closest device.

Documents cited in the International Search Report:

D1: EP 1271293 A2	D3: US 20020044104 A1
D2: WO 0192944 A1	D4: US 20020191004 A1

Documents D3 and D4 define the general state of the art.

Document D1 discloses a system and a method that enable a user to interact with a virtual control panel. The user wears a head-mounted see-through display that shows the user a view comprising the "real world" and the virtual control panel (column 4, lines 24-30). The user can interact with a number of different devices, e.g. domestic appliances and vending machines (column 1, lines 6-18). For example, the

.../...

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/IB2004/004246

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: BOX V

volume of a television set could be adjusted or the television set could be turned on or off (figs. 3a-3d). The user could also receive valuable information about a certain device (column 4, lines 31-39). Information about available commands associated with a certain device, i.e. the graphical interface that represents the control panel of the device, is stored in a database in the system (column 6, lines 12-25). The user selects devices and commands by moving his/her view. However, the description also discloses that commands can be selected by pointing at virtual objects that are visible in the field of view of the user (column 1, line 32-column 2, line 10).

Document D2 discloses a system for generating a virtual display. A mobile display device (6 in fig.2a) is connected to a processing unit (5), which is provided for generating a virtual image (abstract and claim 4). The position of the virtual image is fixed and depends on a reference point that is specified by the user.

The system according to document D1 is considered to represent the closest prior art. The difference between the invention according to claims 1 and 12 and D1 is that the system enables a user to interact with the virtual control panel using a "pointing object". Further, the virtual control panel is projected in a fixed relation to an identification element. As mentioned earlier, the description in D1 also discloses that commands can be selected by pointing at virtual objects that are visible in the field of view of the user. Therefore, this difference is only considered to constitute an obvious, alternative embodiment for a person skilled in the art.

The other difference between claims 1 and 12 and D1, i.e. that the virtual control panel is projected in a fixed relation to an identification element, relates to the problem that the control panel could be in the field of vision of the user and thereby distract him /her. A person skilled in the art, facing this problem, finds a solution in document D2. D2 teaches that a projected image can be

.../...

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/IB2004/004246

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: BOX V

fixed in relation to a reference point that the user specifies.

Thus, a person skilled in the art, having the method and system in D1 as a starting point and aiming to solve the identified problem, would with the knowledge of D2 project the image in a fixed relation to a reference point. Thus, the skilled person arrives at the invention according to claims 1 and 12.

Since D1 and D2 both relate to the same technical field and no unexpected effect is obtained, the combination of what is known from D1 and D2 is considered obvious for a person skilled in the art.

The invention according to claims 1 and 12 is thus not considered to involve an inventive step.

Since the method lacks an inventive step, a computer program, executing said method, also lacks an inventive step.

D1 discloses that the data from the devices could be displayed in the interface and the "pointing object" could be a part of the user's body. The user can interact with different devices and the devices are probably represented by different graphical interfaces. The devices could be provided with bar codes or visual tags to facilitate recognition (column 5, lines 9-27). The user could, in one embodiment, manually choose which device to interact with (column 5, lines 39-48). Further, the display unit in D1 is portable.

Therefore, the invention according to claims 3-8, 11, 12, 14-16 and 18-20 lacks an inventive step.

The subject-matter of the remaining claims, e.g. that the appearance of the virtual control panel could be modified and that the identification element is adapted to be carried by the user, is only considered to constitute details that are obvious for a person skilled in the art.

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WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/IB2004/004246

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: BOX V

What is claimed in claims 2, 9, 10, 13, 17, 21 and 22 is
thus not considered to involve an inventive step.

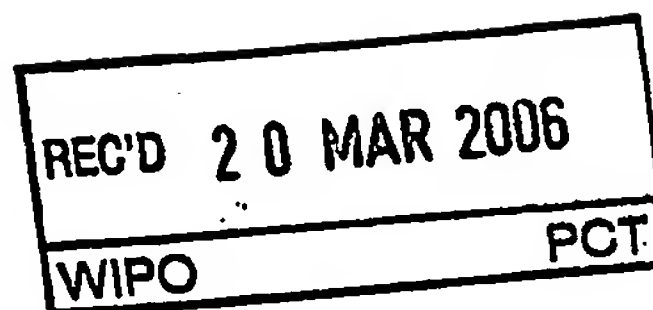
The invention is considered to be industrially applicable.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)



Applicant's or agent's file reference 9628WO/NW/MZ	FOR FURTHER ACTION See Form PCT/IPEA/416	
International application No. PCT/IB2004/004246	International filing date (day/month/year) 20-12-2004 ✓	Priority date (day/month/year) 31-12-2003 ✓
International Patent Classification (IPC) or national classification and IPC See Supplemental Box		
Applicant ABB Research Ltd et al ✓		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 6 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
 - a. ☐ (sent to the applicant and to the International Bureau) a total of _____ sheets, as follows:
 - ☐ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
 - ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
 - b. ☐ (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) _____, containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

- | | | |
|-------------------------------------|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> | Box No. I | Basis of the report |
| <input type="checkbox"/> | Box No. II | Priority |
| <input type="checkbox"/> | Box No. III | Non-establishment of opinion with regard to novelty, inventive step and industrial applicability |
| <input type="checkbox"/> | Box No. IV | Lack of unity of invention |
| <input checked="" type="checkbox"/> | Box No. V | Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement |
| <input type="checkbox"/> | Box No. VI | Certain documents cited |
| <input type="checkbox"/> | Box No. VII | Certain defects in the international application |
| <input type="checkbox"/> | Box No. VIII | Certain observations on the international application |

Date of submission of the demand 01-08-2005 ✓	Date of completion of this report 07-03-2006
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. +46 8 667 72 88	Authorized officer Henrik Eriksson/MN Telephone No. +46 8 782 25 00

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/IB2004/004246

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of: Cover sheet

International patent classification (IPC)

G06F 3/00 (2006.01)

G05B 19/409 (2006.01)

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/IB2004/004246

Box No. I

Basis of the report

1. With regard to the language, this report is based on:



the international application in the language in which it was filed



a translation of the international application into _____,
which is the language of a translation furnished for the purposes of:



international search (Rules 12.3(a) and 23.1(b))



publication of the international application (Rule 12.4(a))



international preliminary examination (Rules 55.2(a) and/or 55.3(a))

2. With regard to the elements of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:



the international application as originally filed/furnished



the description:

pages _____ as originally filed/furnished

pages* _____ received by this Authority on _____

pages* _____ received by this Authority on _____



the claims:

pages _____ as originally filed/furnished

pages* _____ as amended (together with any statement) under Article 19

pages* _____ received by this Authority on _____

pages* _____ received by this Authority on _____



the drawings:

pages _____ as originally filed/furnished

pages* _____ received by this Authority on _____

pages* _____ received by this Authority on _____



a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:



the description, pages _____



the claims, Nos. _____



the drawings, sheets/figs _____



the sequence listing *(specify)*: _____



any table(s) related to the sequence listing *(specify)*: _____

4.



This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).



the description, pages _____



the claims, Nos. _____



the drawings, sheets/figs _____



the sequence listing *(specify)*: _____



any table(s) related to the sequence listing *(specify)*: _____

* If item 4 applies, some or all of those sheets may be marked "superseded."

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/IB2004/004246

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability;
citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	<u>1-24</u>	YES
	Claims		NO
Inventive step (IS)	Claims	<u>1-24</u>	YES
	Claims		NO
Industrial applicability (IA)	Claims	<u>1-24</u>	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

The claimed invention relates to a system and a method that enable a user to interact with a virtual control panel. The invention can be applied to different industrial processes, where a user needs a control panel for interacting with a device or a system. The object of the invention is to provide a portable control panel that the user can carry with him/her. The interaction between the user and the devices is also simplified, since the interfaces can be standardized. The user only has to interact with a single interface, which changes its representation in dependence of the closest device.

Documents cited in the International Search Report:

D1: EP 1271293 A2 D3: US 20020044104 A1
D2: WO 0192944 A1 D4: US 20020191004 A1

Documents D1 and D2 have been reconsidered to define the general state of the art. Documents D3 and D4 also define the general state of the art.

Document D1 discloses a system and a method that enable a user to interact with a virtual control panel. The user wears a head-mounted see-through display that shows the user a view comprising the "real world" and the virtual control panel (column 4, lines 24-30). The user can interact with a number of different devices, e.g. domestic appliances and vending machines (column 1, lines 6-18). For example, the volume of a

.../...

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of: BOX V

television set could be adjusted or the television set could be turned on or off (figs. 3a-3d). The user could also receive valuable information about a certain device (column 4, lines 31-39). Information about available commands associated with a certain device, i.e. the graphical interface that represents the control panel of the device, is stored in a database in the system (column 6, lines 12-25). The user selects devices and commands by moving his/her view. However, the description also discloses that commands can be selected by pointing at virtual objects that are visible in the field of view of the user (column 1, line 32-column 2, line 10).

Document D2 discloses a system for generating a virtual display. A mobile display device (6 in fig.2a) is connected to a processing unit (5), which is provided for generating a virtual image (abstract and claim 4). The position of the virtual image is fixed and depends on a reference point that is specified by the user.

The system according to document D1 is considered to represent the closest prior art. The invention according to claims 1 and 12 differs from D1 in that the system enables a user to interact with the virtual control panel using a "pointing object". Further, the virtual control panel is projected in a fixed relation to an identification element, i.e. the control panel will follow the identification object as if it is physically attached to the element.

The subject-matter of claims 1 and 12 is therefore novel (Article 33(2) PCT).

The difference between the claimed invention and D1 relates to the problem that the control panel could be in the field of vision of the user and thereby distract the user. The solution to this problem is proposed in claims 1 and 12 of the present application. The control panel will follow the identification object as if it is physically attached to the element. Hence, the user can put the virtual control panel away when doing other tasks.

The cited prior art does not give any indication that would

.../...

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: BOX V

lead a person skilled in the art to the claimed system and method. Therefore, the claimed invention is not obvious to a person skilled in the art. Consequently, the invention according to claims 1 and 12 is considered as involving an inventive step (Article 33(3) PCT).

The remaining claims are dependent on claims 1 and 12, and as such also meet the requirements of the PCT with respect to novelty and inventive step.

The invention is industrially applicable.

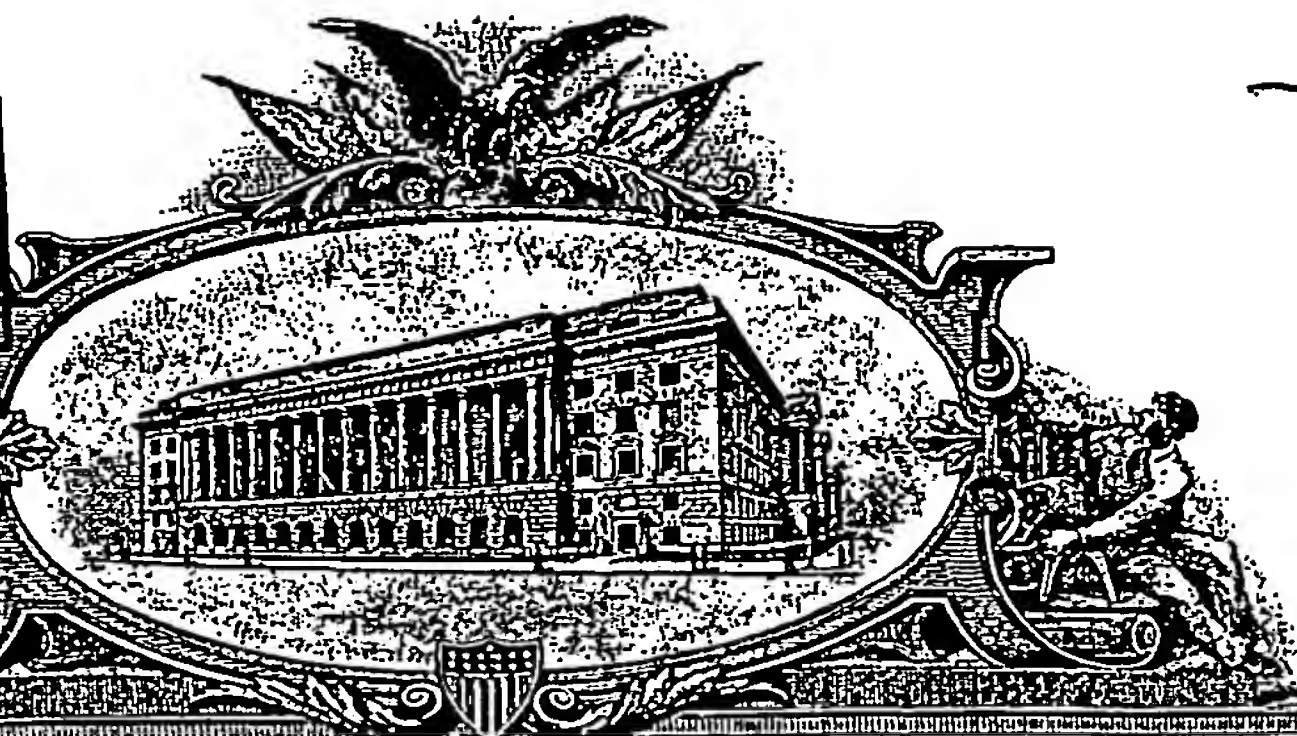
REC'D 07 APR 2005

WIPO

PO

PA 1288280

TB/04/04246



THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:
UNITED STATES DEPARTMENT OF COMMERCE

United States Patent and Trademark Office

March 09, 2005

THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY FROM
THE RECORDS OF THE UNITED STATES PATENT AND TRADEMARK
OFFICE OF THOSE PAPERS OF THE BELOW IDENTIFIED PATENT
APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A
FILING DATE UNDER 35 USC 111.

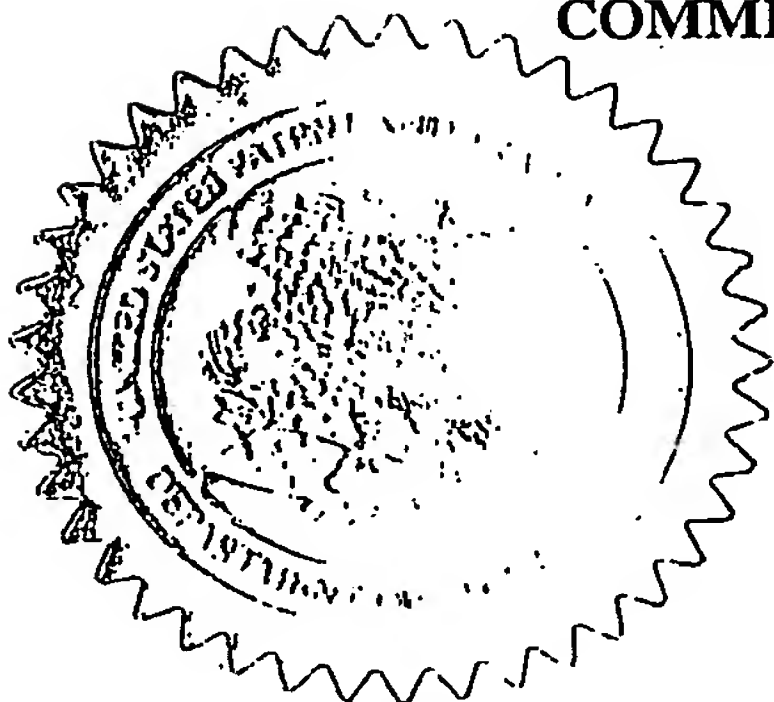
APPLICATION NUMBER: 60/533,246 ✓

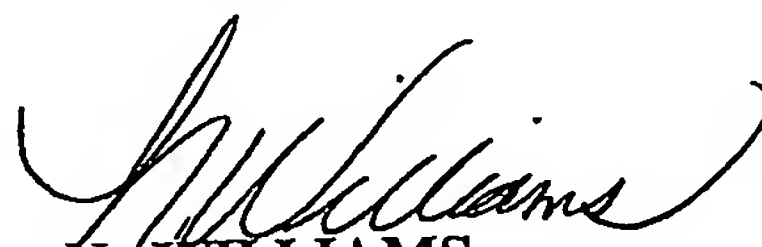
FILING DATE: December 31, 2003 ✓

PRIORITY DOCUMENT

SUBMITTED OR TRANSMITTED IN
COMPLIANCE WITH RULE 17.1(a) OR (b)

By Authority of the
COMMISSIONER OF PATENTS AND TRADEMARKS




N. WILLIAMS
Certifying Officer

13281 U.S. PTO

PTO/SB/16 (08-03)

Approved for use through 07/31/2006. OMB 0651-0032

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53 (c).

Express Mail Label No.

INVENTOR(S)					
Given Name (first and middle (if any))	Family Name or Surname	Residence (City and either State or Foreign Country)			
Charlotte	Skourup	Drammen, Norway			
John	Pretlove	Sandvika, Norway			
Thomas	Pettersen	Oslo, Norway			
<input type="checkbox"/> Additional inventors are being named on the _____ separately numbered sheets attached hereto					
TITLE OF THE INVENTION (500 characters max)					
A VIRTUAL CONTROL PANEL					
Direct all correspondence to:		CORRESPONDENCE ADDRESS			
<input checked="" type="checkbox"/> Customer Number		23517			
OR					
<input type="checkbox"/> Firm or Individual Name	Edward A. Pennington, Swidler Berlin Shereff Friedman, LLP				
Address	3000 K Street, NW				
Address	Suite 300				
City	Washington	State	DC	ZIP	20007-5116
Country	US	Telephone	202-424-7500	Fax	202-295-8478
ENCLOSED APPLICATION PARTS (check all that apply)					
<input checked="" type="checkbox"/> Specification Number of Pages		22	<input type="checkbox"/> CD(s), Number _____		
<input checked="" type="checkbox"/> Drawing(s) Number of Sheets		2	<input type="checkbox"/> Other (specify) _____		
<input type="checkbox"/> Application Data Sheet. See 37 CFR 1.76					
METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT					
<input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27.				FILING FEE AMOUNT (\$)	
<input type="checkbox"/> A check or money order is enclosed to cover the filing fees					
<input checked="" type="checkbox"/> The Director is hereby authorized to charge filing fees or credit any overpayment to Deposit Account Number: 19-5127				160	
<input type="checkbox"/> Payment by credit card. Form PTO-2038 is attached.					
The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.					
<input checked="" type="checkbox"/> No.					
<input type="checkbox"/> Yes, the name of the U.S. Government agency and the Government contract number are: _____					

Respectfully submitted
SIGNATURE

(Page 1 of 2)

Date

December 31, 2003

TYPED or PRINTED NAME

Eric J. Franklin

REGISTRATION NO.
(if appropriate)

37,134

Docket Number:

19378.400 233

TELEPHONE

202-424-7500

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19587 U.S. PTO
60/533246

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5 A VIRTUAL CONTROL PANEL

FIELD OF THE INVENTION

10 The present invention relates to a system and a method that enables a user to interact with a virtual control panel using a user controlled pointing object. The system comprises a first tracking unit adapted to capture data representing the position of the pointing object.

15 The virtual control panel represents interfaces for real-time human-system interaction. The invention can be applied for different industrial processes where an operator needs a control panel for interacting with a device or system regarding real-time data, historical data, simulations, test data, etc. The invention is
20 particularly useful in automation applications.

PRIOR ART

25 Field operators (e.g. in process plants, manufacturing, at offshore platforms and substations) need both to interact with systems or devices and to have access to information and documentations. Various user interfaces, both physical and software interfaces, towards devices and system are often designed differently and the field operators have to learn to use every single
30 user interface system. In addition to the two-way interaction with devices/systems, the field operators need access to documentation such as manual, historical data, maintenance & repair reports, P&IDs, etc. Even though the trend is that such documentation becomes electronically available, it often resides at different
35 systems and locations. Therefore, the field operators have to plan their work tasks in advance, or they even have to interrupt

ongoing tasks in order to control the process/devices and find supportive information and documentation.

5 Within manufacturing, a production line includes several robots which are controlled by separate controllers and teach pendants. The operators need to interact with the robots, for example, in order to check status, inspect the robots and make new programs. A general drawback is that the operators must change interaction device for each new robot even though several robots may perform a task together.

15 Augmented Reality (AR) is a method of overlaying real world representations with computer-generated graphics. Ideally, for vision-based augmented reality, the user will not be able to recognize the difference between the real and the computer-generated graphics, and thereby the user will get an improved perception of the real world environment. Today, augmented reality techniques are used in a number of applications. Examples of use are within media (weather reporting), medicine (visualisation of internal organs), for collaborative environments (virtual meeting room) and in process industries (for maintenance, service).

25 A handheld/wearable control panel with interaction possibilities already exists and the interest of such devices increases. The use of mobile phones and PDAs as the interface towards systems/devices is known. Also, tablet PCs, which are used, e.g. within hospitals, provide an interface that the user easily carries around and interacts with by touching the screen. The newest field that is related is virtual keyboards. A virtual keyboard is projected, e.g. at a table, and will typically be the input mean for a PDA. The user touches/presses the keys and the system recognizes the specific touched keys like a standard keyboard. Virtual keyboards are commercial products offered by several manufacturers, e.g. Canesta, Senseboard Technologies and Samsung.

The issue of interacting with virtual graphics has been addressed, for example, in the film "Minority report". There is a scene where Tom Cruise uses his hands to interact with virtual information visualized on a Plexiglas "wall". He further uses gestures for the interaction.

US 6,614,422 discloses a digital user input to a companion system such as a PDA, a cell telephone or an appliance device, using a virtual input device such as an image of a keyboard. A sensor captures three-dimensional positional information as to location of the user's fingers in relation to where keys would be on an actual keyboard. This information is processed with respect to finger locations and velocities and shape to determine when virtual keys would have been struck. The processed digital information is output to the companion system. The companion system can display an image of a keyboard, including an image of a keyboard showing user fingers, and/or alphanumeric text as such data is input by the user on the virtual input device.

US 6,618,425 disclose a virtual laser operator. A laser controller interconnected with an electric discharge laser communicates with a remote computer incorporating a display screen programmably emulating a conventional keyboard. The display screen has a plurality of imaged virtual keys each programmably emulating a physical key of a conventional keyboard. A keystroke is typically applied by manually pressing the position of a corresponding virtual key on a touch sensitive screen, or alternatively by actuating a conventional pointing device.

OBJECTS AND SUMMARY OF THE INVENTION

The object of the present invention is to provide a portable control panel that the user can carry with him and which almost weighs nothing.

This object is achieved by means of the initially defined system, characterized in that that the system further comprises: a portable identification element, a second tracking unit adapted to capture data representing the position of the identification element, a storage unit, storing at least one pre-defined graphical interface representing a control panel of a device, said graphical interface comprising an interface for user interactions with the device, a graphics unit, generating a graphical representation of the control panel based on said stored graphical interface, a registering unit, registering said graphical representation of the control panel in a fixed relation to said portable identification element, based on said data representing the position of the identification element, to produce a virtual control panel, a display unit, showing the user a view comprising the real world and the virtual control panel projected in a fixed relation to said portable identification element, and an application unit, performing actions in response to the users interactions with the virtual control panel, and determining which actions to be performed based on the position of said user controlled pointing object in relation to the identification element.

Preferably, said portable identification element is adapted to be carried by the user during interaction with the virtual control panel. The user for example carries the identification element in his hand or attached to his body.

The identified device can also be a system.

The weight of the virtual control panel and the fact that it can be attached to the body, e.g. an arm or a watch, are clear advantages of the virtual control panel.

Preferably, said user controlled pointing object is a handheld pointing device or a part of the user's body.

According to an embodiment of the invention said graphics unit, is adapted to modify said graphical representation of the control panel in response to interactions between the user controlled pointing object and the virtual control panel. This embodiment provides the user with the ability of interaction with the control panel, for example scroll and look into menus.

According to an embodiment of the invention said graphical interface is adapted for displaying data from the device and that the system is adapted to generate a graphical representation of the data and displaying the data on the virtual control panel, in response to interactions between the user controlled pointing object and the virtual control panel.

According to an embodiment of the invention, the storage unit is adapted for storing a plurality of graphical interfaces, each representing a control panel of a particular device, that the system is adapted to generate and display a plurality of graphical representations of control panels for different devices based on said stored graphical interfaces of the devices and that the system comprises means for identifying which of the stored control panels to be displayed.

According to an embodiment of the invention said means for identifying which of the stored control panels to be displayed comprises a recognition unit for recognizing and identifying devices in the environment of the user and that the graphics unit is adapted to generate a graphical representation of the control panel of an identified device based on the stored graphical interface of the identified device. For example said recognition unit is adapted for recognizing and identifying unique identification markings on the devices. This embodiment provides the human operator with a virtual control panel that adapts its "look" and content to the device/system which the operator stands in front of, or closest to.

According to an embodiment of the invention the system is arranged so that it automatically changes the virtual control panel displayed when another device is recognized and identified.

- 5 According to an embodiment of the invention said display unit comprises a head mounted display showing the user said view. In another embodiment the view is projected on the eyes of the user.
- 10 A further object of the invention is to provide a method that enables a user to walk around and interact with a virtual control panel using a user controlled pointing object.

15 This object is achieved by the method of the invention as defined in claim 12.

20 According to an aspect of the invention, the object is achieved by a computer program directly loadable into the internal memory of the computer or a processor, comprising software code portions for performing the steps of the method according to the invention, when said program is run on a computer. The computer program product is provided either on a computer readable medium or through a network, such as the Internet.

25 According to another aspect of the invention, the object is achieved by a computer readable medium having a program recorded thereon, when the program is to make a computer perform the steps of the method according to the invention, and said program is run on the computer.

30 This invention describes a system and a method for a virtual control panel that adapts its look and content to specific devices/systems, for example to the closest system/device. The virtual control panel is implemented as augmented reality (AR),
35 that is computer-generated graphics combined with the real world. The field operator "carries" the virtual control panel with

him. The virtual control panel is attached to, for example, a unique ID, which is recognized by a tracking system. The field operator preferably wears glasses or HMD (head-mounted display) on which the computer-generated graphics are projected (either as optical see-through or video see-through). The virtual control panel only exists as data projections. The virtual control panel represents the user interface for interacting with process devices and/or systems. Examples are status monitoring, set point changing, reports and other textual documents, historical data in form of trend curves, 3D simulations, interaction buttons and menus. The virtual control panel adapts its look/interface to the related device/system (may also be identified with unique IDs recognized by the tracking system).

The virtual control panel changes its look and functionality regarding which device/system it is close to. A recognition unit detects the identity of the closest device/system. The AR system visualizes the related virtual control panel, which may provide a range of different information and information presentations. The field operator interacts with the virtual control panel using an input device or his fingers/hands. Also, other interaction means may be used such as voice and physical interaction buttons / haptic means. The field operator navigates in the different views of the virtual control panel. When the operator moves towards another device/system, the virtual control panel changes its look to represent the new device's/system's functionality and characteristics. The representations of the different virtual control panels are defined in advance and stored at a computer or a server. In addition to historical data, real-time data and information is visualized on the virtual control panel.

In one use-case, an operator (a system or process expert) working within the plant needs to check and update an existing robot program to make sure that the program modules are downloaded and related to the right robots (four robots included in the program). He then has to log in at the each of the four

teach pendants, one at a time, scroll down in the menus and find the right program and the right place in the program. By utilizing the proposed invention, the operator would only need to walk next to the appropriate robot and then check the program for each of the four robots. Costs related to maintaining the teach pendants will be reduced. Also, the problem with wires between the robot controller and the teach pendant is avoided with the virtual control panel.

- 10 In process plant environments the operator walks around and performs monitoring, inspection and maintenance tasks related to a process or device. The operator typically has two-ways radio communication with the control room operators to transfer information to and from the process. The virtual control panel
- 15 provides the field operator with an interface for online interacting with the various devices and systems in the field as well as a tool for viewing documentation, reports, maintenance and service procedures, etc. The operator always carries the virtual control panel with him. He can put it aside, or attach it, e.g. to
- 20 his arm, while doing other tasks. The field operator will be able to perform his tasks more efficiently. Also, the use of the virtual control panel prevents errors due to communication problems between the field operator and the control room (misunderstandings, noise, etc.). The control room operators may also have the
- 25 opportunity to see updated data and information from the plant.

The virtual control panel can be used for other applications such as registration and counting in stores. Combined with bar codes, the virtual control panel may visualize information related to the registered part, etc. The user can enter data and information as well as reading status and documentation. Office tool

Another example application is an office. The virtual control panel may provide the user with names of people by passing the doors, or the people themselves if the employees are equipped with IDs. For example, the security staff may have virtual control

panels for checking IDs, changing passwords, recording status information from their check rounds, etc.

Advantages gained by this invention is that the field operator always has the control panel with him, easy standardization of the various user interfaces, the operator only interacts with a single interface which changes its representation (look and content) regarding the closest functionality and characteristics device/system, the virtual control panel almost weights nothing. The field operator can put the virtual control panel aside while he is doing other tasks, e.g. put it down on a table, the floor, etc. The virtual control panel itself has no need for ruggedised/intrinsic safe certification.

15 BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be explained more closely by the description of different embodiments of the invention and with reference to the appended figures.

20 Fig. 1 shows a system for providing a virtual control panel according to an embodiment of the invention.

25 Fig. 2 shows a block scheme over a system according to the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

30 This invention proposes a system and a method for providing a virtual control panel which adapts its interface and content to a device and/or a system. The system comprises the following:
A handheld interacting and pointing device with a tracking system for determining its position and orientation in relation to a
35 world coordinate system.

A handheld or otherwise wearable unique ID including a tracking system for determining its position and orientation in relation to a world coordinate system.

5 A wearable display device (glasses, head-mounted display or head-up display) for visualizing augmented reality overlaid the view of the real world.

Unique IDs for placing at objects (devices and systems) in the environment including a recognition system for recognizing the unique IDs.

10 In case video see-through is used for augmented reality visualization, the display device further comprises:

A camera for capturing a stream of images of the environment mounted on or integrated with the display device. The camera will be mounted in a fixed position at the display device, and the
15 display device will be located along the camera view axis and at the camera's image plane.

A system for generating an augmented reality representation of computer-generated graphical information overlaid the real world.

20 The system can be configured in different ways.

The two most likely ways of visualizing augmented reality are Video see-through and Optical see-through. Video see-through needs a camera to capture a live video stream of the environment corresponding to the user's view of the world. The system
25 combines computer-generated graphics with the live video stream and projects the combined augmented reality video onto the display device. The user will see the video with overlaid virtual information as if he/she was looking at the real world. For
30 optical see-through, the computer-generated graphics are registered directly onto (combined with) the display device and follows the user's view of the real world. The virtual graphics are overlaid the real world without including a video of it. The former solution is less demanding regarding the frame rate.

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Basically, two tracking systems are needed for the virtual control panel system in addition to a recognition system for recognizing IDs attached to the devices/systems in the environment. The first tracking system traces and determines the interacting and pointing device whereas the second tracking system traces and determines the ID held by the user. These tracking systems may be a single tracking system used for tracing both, or two different tracking systems. A vision-based tracking system including a camera mounted on, or integrated with, the display device is one solution which may be combined with AR visualization based on video see-through. Examples of tracking systems are ultrasonic tracking systems, magnetic tracking systems, tracking systems based upon inertial navigation (using accelerometers and gyros), mechanical arms, vision-based and optical systems and hybrid systems combining technologies previously mentioned. For some of the tracking systems, the interacting and pointing device and the handheld/wearable ID (held by the user) may have integrated sensors for determining positions and orientations. Such sensors may, for example, be gyros, inertial sensors and accelerometers.

The origo of the world coordinate system is defined to correspond with the display device. As the camera is mounted on, or integrated with, the display device, the relation between the camera and the display device is known. Hence, the system determines the poses of the interacting and pointing device and the handheld ID in relation to the camera/display device system.

The system also needs to recognize the predefined IDs in the environment. These IDs are attached to devices and systems which the operator wants to interact with. Different technologies can be used for the recognition such as RF tagging, bar codes, ultrasound and GPS. Alternatively, a tracking system as described above can be used to recognize/trace the positions of the device/system IDs.

The user wears a display device (either wearable glasses or a head-mounted display/ head-up display), a wearable computer, a handheld or otherwise wearable unique ID, and an interacting and pointing device.

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First, a fixed world coordinate system needs to be defined. The origo of this coordinate system is aligned with the display device so that all pose information provided by the tracking systems is related to this world coordinate system.

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In advance, personnel place predefined unique IDs at devices and systems in the environment, which the operator needs to interact with. In relation to each device and system, virtual interfaces need to be defined in the system. Also, potential communication between the virtual interfaces and the devices/systems must be defined and set up in advance.

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When the operator starts using the system, he walks around in the environment until he comes to a device/system which he wants to interact with. He moves the handheld/wearable ID next to the device/system until the system has recognized the specific device/system. The related virtual interface appears as a virtual control panel attached to the handheld/wearable ID. The operator uses the interaction and pointing device to interact with the virtual control panels, which may include interaction buttons, menus and other types of interaction possibilities. The virtual control panel updates its look and content corresponding to the operator's choices. Alternatively, the operator may use his hand(s) and finger(s) for interacting with the virtual control panel. The system still needs to determine the pose of the interaction body part. A similar tracking system as for the interacting and pointing device can be used for hand/finger tracking. The system further needs a recognition system in order to recognize the interacting body part (hand(s) and finger(s)) and determine its position.

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The virtual control panel changes its look and content as the operator either moves along to a new device/system, which has attached an ID, or interacts with the virtual control panel. Examples of the virtual interfaces are device/system overviews, status information, set points, trend curves, documentation, video clips, e.g. for maintenance and procedures, and data entry.

The virtual control panel can be combined with other interaction modalities such as voice and tactile feedback. Typically, the virtual control panel may give an audio feedback when the operator pushes an interaction button.

The operator can move the handheld/wearable ID freely (both regarding position and orientation) and the virtual control panel will follow the ID as it is physically attached to the ID. The related tracking system captures the movements of the handheld/wearable ID and transmits the pose to the wearable computer by means of a communication link, e.g. wireless communication. Hence, the operator can put the virtual control panel away (e.g. in a pocket) when he/she is not using it, or put the virtual control panel on a table, etc. when doing other tasks.

The wearable computer communicates by wireless communication with the devices/systems, e.g. to retrieve and send data. Readings from the devices/systems may be presented on the virtual control panel whereas the operator may modify, e.g. the set point of a device/system.

Video see-through is used to generate and present an AR world at the handheld/wearable ID representing the virtual control panel. The camera integrated with the display device is used to capture a live video stream of the real world. The camera is located in relation with the display in such a way that it provides the same view as the user would get by looking directly at the real world. The live video stream combined with computer-generated graphics is presented in real-time at the display device. Additional functionality includes camera zooming with out-

put of the actual camera focal length. This will enable the system to display the computer-generated graphics correctly while zooming. The camera may also be used for vision-based tracking if vision-based tracking is used as the tracking system.

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Figure 1 shows an embodiment of a system according to the invention. The operator (1) walks around in the environment. The tracking system (6) recognizes known IDs (4, 9) in the environment. The operator holds an ID (4) in his hand or wears it on his
10 body, e.g. around his hand wrist. In case the tracking system is vision-based, the operator wears a camera (7) attached to his head. The camera (7) records live video of the real world. The camera (7) may also be used for the augmented reality visualization of the virtual control panel in case the "video see-
15 through" method is used.

The operator (1) carries an ID (4), which will provide him/her with an augmented reality view of the control panel. The virtual control panel is visualized either as "optical see-through" or "video see-through" at the wearable display (3) (wearable glasses
20 or head-mounted display/head-up display). The user has an interacting and pointing device (5) for interacting with the virtual control panel. The interacting and pointing device (5) may have an integrated tracking system making it possible to point at
25 poses in the environment and to interact with the system. Alternatively, the camera (7) may be used as vision-based tracking of the interacting and pointing device.

Devices/systems (8) in the environment have some type of IDs
30 (9) attached so that the tracking system (6) recognizes the specific device/system. The tracking system (6) determines the position and orientation of the devices/systems based on the IDs (9). The IDs (9) have corresponding virtual interfaces which are
35 presented as the virtual control panel.

35

A wearable computer (2) or a stationary computer contains the necessary software in order to generate the augmented reality control panel based upon the output from the tracking system (6) and the video stream from the camera (7) (in case video see-through is used). The wearable computer (2) also contains the necessary software needed to perform the desired task or process, e.g. (two-ways) communication with devices/systems, real-time data managing and visualisation. Further, the wearable computer (2) will generate the graphics, which will provide the AR interface view. Finally, the wearable computer (2) will contain a storage media in order to save, and restore previously saved, information.

Communication of the information from the interaction and pointing device (5) to the wearable computer (2) is done through a wired or wireless link. Depending on the type of tracking system, the pose of the interacting and pointing device (5) can come from the pointing device itself, or from an external tracking system. Communication is performed through a wired or wireless communication media.

Figure 2 shows a block scheme over the system. The application unit (21) contains the necessary software in order to perform the desired process or task, e.g. integrate real-time data with recognized device/system, and perform actions based on input from the interacting and pointing device. The tracking system will make it possible to trace the pose of the interacting and pointing device (5) in 3D, and can also be used for specifying the world coordinate system. The interacting and pointing device can also be used for additional tasks such as to drag a virtual control panel, or other virtual information, from the handheld ID to a specific device/system and to locate, select, show, etc. new positions in the environment. Further, the application unit holds information regarding the coordinate systems. Hence, the application unit (21) is dependant on the specific system/environment.

The operator uses an interaction and pointing device (5) which are tracked by a tracking system (20) which may be integrated with the interacting and pointing device. The user uses the interacting and pointing device (5) for interacting with the virtual control panel and for pointing in the environment.

A graphics unit (23) generates a 3D graphical representation of the visual information that is to be displayed in relation to the user's ID (4). That is, this unit holds a specification of the 3D graphical primitives to be visualized. The graphics unit (25) receives information from the application unit (21) regarding the virtual graphical information to be displayed based on user input. All graphical primitives positions are specified in relation to the world coordinate frames. For the robot programming application relevant visual information may be operator-specified waypoints, the actual robot path, task specific information etc. The graphical representations in the graphics module are transmitted to the registration unit (25).

The registering unit (25) combines the virtual graphics from the graphics unit (23) with the real world view. In case the video see-through method is used, a live video of the real world image from the camera system unit (26) is captured and combined with the graphical representation from the graphics unit (23). The registering unit (25) uses the pose data from the ID tracking system unit (24) in order to overlay the real world images with the computer-generated graphics. With the registration correctly done, the computer-generated graphics will be virtually "attached" to the real world scene.

In case video see-through, a camera unit (7) attached to the display device (3, 27) produces real world images. The pose of the camera and display is determined according to the world coordinate frame, and is used by the registering unit (25) in order to overlay the real world scene with computer-generated graph-

ics from the graphics module (23). The combined images are displayed on the display device (27). Alternatively, the registering unit (25) overlays the real world with the computer-generated graphics (optical see-through).

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A storage unit (22) enables saving and loading of application related information, e.g. application related information, graphical interfaces for the various devices/systems, and system configuration parameters (e.g. local and world coordinate frame).

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The present invention is not limited to the embodiments disclosed but may be varied and modified within the scope of the following claims. For example